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An Investigation in printing from a remote field location using wireless communications

Brenda Beden

An Investigation into Printing from a Remote Field Location Using Wireless Communications

by

Brenda K. Beden

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Thesis Advisor: Professor Emery Schneider

School of Printing Management and Sciences
Rochester Institute of Technology
Rochester, New York

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Brenda K. Beden

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for the thesis requirement for the Master of Science degree
at the convocation of

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Thesis Committee:

Emery Schneider

Thesis Advisor

Graduate Program Coordinator

Director or Designate

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Using Wireless Communications

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Abstract

Computers have changed the way our society works. Everyday life is somehow effected by a computer. It has changed the way many industries do their business. The business world is now a global community.

The Graphic Arts industry has been impacted by these changes. With computers, documents are now found in digital form. Instead of being hand prepared, they are compiled within the computer realm. By using modems, these documents can travel from one location and be printed at several different locations, even world wide.

As the computer evolves, it is also becoming more portable so that our mobile society is not tied to one location. Along with this mobility, there is a strong trend in communications that are mobile also. Wireless technologies are advancing at a rapid rate to keep up with customer demand.

By combining these emerging technologies, is it possible that a person with some knowledge of computers and peripherals, desktop publishing, and digital photography can transmit documents using cellular communications from a field location to a digital press to produce a finished product?

A digital camera was used to capture images for a test document. The images were then downloaded to a laptop computer. From there changes were made to the images that fit the parameters of the final output device. Using Quark XPress the test document was prepared. It included four of the images taken with the digital camera. When the document was complete it was saved to a PostScript file.

The transmission of the file was possible by using a PCMCIA Fax/modem card installed in the portable computer. This was connected using a special cellular phone adapter with a Motorola Elite Cellular Phone.

Two transmission tests were attempted. The first test used the internet as a means to connect to the file server at the Digital Publishing Center at Rochester Institute of Technology. The second test used Xerox proprietary software Launch to link the computer to the file server at Suttons' Printing in Grand Junction, Colorado.

In test one, the transmission of the file was complete. Upon going to the Digital Publishing Center, the file was transferred from the file server to the job manager on the Docutech 9500. A proof was made and fifteen final copies were produced.

In test two, the transmission was unable to be completed. The file server was accessed and logged on but the downloading of the file was never completed. The file server would disconnect shortly after the downloading process would begin.

Test one results showed that it is possible to transmit a digital file using wireless communication and successfully print an acceptable quality product. Test two shows that it is possible that problems can occur so that transmission cannot be completed.

This technology is still in its infantile stages. As these technologies continue to advance this type of transmission could become more common place, allowing printing to take place anywhere.

Chapter 1

Introduction

Technological changes in the Graphic Arts industry have made it possible for anyone who has access to electronic publishing to print from any populated location. The intent of this project is to demonstrate that printing a document can take place from any remote field location by means of a portable computer, modem, internet connection, telecommunications and a digital press. This demonstration will provide results and a guide by which others can produce printed documentation from their remote location.

As communications have advanced technologically, more and more people have access to information that helps inform and educate them. The knowledge found in books in the Dark Ages was only available to the rich. It took years to copy books by hand therefore only a limited number of books were available.[1]

When Guetenburg began using movable type with the printing press, books and information became more available for the common person. It was the beginning of educating the populous. But even with this marvelous invention it still took time to create the printed page.[2]

With the advances that have occurred over the last decade publishing and printing are becoming easier and faster. Thanks to the Information Age, the dissemination of information is at an all time high.[3]

For most of us, when we need a publication printed, we go to our local printer and place an order to have the document printed. Depending on the complexity of the job and the schedule, we have our printed publication, in hand, anywhere from the next day to a week later.

In the western half of the United States and in many countries around the world, there are populations that are isolated from the sophisticated technologies of modern urban communities. They too have printing needs, and often those needs can not be met by the local printer. Instead of a week turn around time, these customers must spend three to four weeks and extensive travel to end up with the same printed publication.

With the new technology of communications, a person having access to wireless communications can be in contact with the world at any given time. This rapidly changing technology is on the leading edge and is changing the way people perform their daily routines.

If we can combine the wireless technology with the printing world it should be possible for a person to print from any location provided that the proper tools are available.

Endnotes for Chapter 1

[1]David Bergsland, *Printing In A Digital World.* (Albany, NY: Delmar Publishers, 1997), 4.

[2]Ibid., 162

[3]Ibid., 453

Chapter 2

Theoretical Basis of the Study

We have moved from preparing documents by hand to preparing them on the computer. In order to produce a document, a person sets the type, positions it on the page, produces drawings and/or tables and can even manipulate photographs. With the invention of digital photography, time is not needed for processing and printing of photographs. Images now can go straight from the camera to the digital page. The entire document, including pictures, can exist in digital form.

The modem allows transmission of information from one location to another. Once the document is in digital form it can be sent to one or several different locations, what ever the need may be. By using the internet, the document producer can even shop for a digital printing center in the location to which the document will be sent. Many printing centers now use the internet as a way of connecting with some of their customers.

Digital printing, another new technology, will make remote site printing even more possible. At this time, digital printing most often utilizes a Xerox Docutech. This high speed printer, as well as others, produce laser quality copies. One method of producing copies is by using a network. A network allows more than one computer to connect to other computers and/or printing devices. This network allows a person outside the printing facility to transmit, via modem, the document information to a remote digital printer such as the Docutech. This function also allows contact with multiple locations if

necessary. The digital document information is stored on a server until output is needed. A server is a piece of hardware, usually a computer, that is dedicated to managing information that is shared between computers. Now documents produced at the off site location can be sent at any time without ever having to set foot in the print shop to have copies made.[1]

Advertising and sales promotion indicates that all of this technology is available and working well. If we can produce documents in normal surroundings then we can now assume that the same task can be done using portable hardware and cellular phones. If this is so, then it would mean that documentation could take place anywhere, regardless of point of origin. For professions working in remote environments, like archaeologist, geologist and environmentalists, this would mean that information could be sent out for distribution at greater speed.

In order to understand how this procedure takes place, it is necessary to review the development of the technological advancements which have occurred in recent years.

Background Theory

In the 1960s NASA investigated the possibility of capturing images from space. They used television cameras to record the images, and then transmitted the image by radio signals, back to earth. They found that the farther away the transmitting source was, the more difficult it was to receive and correct the information. Often times the signal was so weak that information was completely lost. In the mid sixties they began experimenting with digital techniques. They found that transmission was superior to previous techniques used and information could be transmitted over longer distances without losing quality.[2]

So what is the difference between analog and digital? It is because of these two

techniques that the processing and transmission of information can take place.

> "Analog Signals: Analog signals use electrical waves, physical forces, objects, or distances, to proportionally represent the measurements and attributes of an entity and to transmit messages. Analog signals may take an unlimited number of shapes or forms.
> Digital Signals: Digital signals represent information in numbers. Digital systems use only a limited set of discrete symbols to describe all of the attributes and measurements of an entity and to transmit messages. In the high-tech world, binary numbers are the most commonly used digital signals."[3]

An example of analog vs. digital can be shown by calculating time:

Using a standard wrist watch with hands(analog) and a digital watch(digital), stop both watches at the same time; 7:38. Then ask several people to record the time. Using the standard watch, the time recorded will vary in how each person interprets the time they see. Using a digital watch, the time will be recorded the same each time. This works because the digital watch uses numbers to represent the time. It is easier to repeat numbers than it is to repeat a pattern. Even though both systems are accurate, the digital system has less chance of error.[4]

Imaging Technology

Today almost all computers utilize digital format to reproduce information. When a page layout is produced on the computer, it is in digital form. Up until recently, photographs had to be reproduced in hard copy(analog) and then scanned(digital) and dropped into position on the page. By using the scanner, the photograph was turned into digital information.

All systems, whether scanners, digital cameras or printing devices use resolution to describe how well the image will reproduce. Often the term "addressability" will be used

in conjunction to resolution. These terms are often confusing but work hand in hand towards the final image. Michael Stoudt, Ph.D., general manager of Color Demand Printing for Eastman Kodak Company defines them as:

> "Addressability is a measure of how many points a system can address in a given space (e.g., 600-dpi addressability means the writer can write to 600 different points in one inch).
>
> Resolution is, given an addressability, the system's ability to resolve two side-by-side or in-line channels of address. Image spot size, developing technology, and toner size all determine whether the neighboring channels of address are actually resolvable. In fact, most systems are designed not to resolve side-by-side signals, but rather have a significant overlap because this will reduce "staircase" effects for curved lines."[5]

Resolution is given in different formats. Spots per inch or spi, commonly refers to the addressability of the printing device. Dots per inch or dpi is one of the most common. Its history is derived from the halftone dot used in printing photographic images. A dot is made up of spots. Pixels per inch or ppi, refers to picture elements or the individual squares that make up the image you see on your monitor. Pixels are also used to describe the capacity of a CCD array whether it is on a scanner or in a digital camera.[6]

The scanner uses a beam of light that is passed over the image in a grid like fashion. As the beam is reflected off the copy, it passes through a Charged Coupled Device (CCD: an image sensor used in scanners and digital cameras) and photo multipliers and is converted into digital signal. The computer records information such as density (light or darkness) and color and assigns a number or value to that grid of information. It then holds that information in storage until it is needed. At this point the image can be manipulated, retouched and/or enhanced.[7]

Digital cameras record the image much the same as a scanner. When the shutter is opened the CCD records the light values and notes those values just like scanning the image.

> "CCDs are simple devices that generate packets of electrons that represent, in analog form, the degree of illumination. The CCD is efficient throughout the visible light spectrum and can respond to very low levels of light."[8]

There are two types of CCDs. The first type is a linear array. This type of sensor has many pixels in a row. The linear array has the capacity to hold upwards of 8000 pixels in one row and sometimes more than one set of pixels will be used at one time. They can be set end to end in a linear fashion. The sensor must be moved over the image in a grid like system to capture the reflective light of the image. This type of CCD is most often used in scanners.[9]

The second type of CCD is an area array. This type is commonly used in digital cameras because the whole sensor is exposed at one time. The CCD is rectangular in shape and has a given amount of pixels for the rectangular area, such as 640 x 480. These sensors are very sensitive to light and as the shutter is opened the image is recorded on the CCD. The resolution of the image is dependent upon the number of pixels available in the array, although there are many factors that go into determining the final resolution of the image. The lower the number of pixels, the lower the resolution capacity.[10]

As digital photography becomes more popular and practical in its applications, more choices of cameras will probably become available. Just like in traditional photography, there is a range of inexpensive low-end cameras to the expensive high-end cameras with attachments and options.

Most of the low-end digital cameras use a point and shoot system. They have a limited resolution that is dependent upon the number of pixels in the array, with the most

common resolutions of 320 x 240 or 640 x 480 pixels. Low-end cameras have very limited options, such as exposure settings and interchangeable lens. Even though these cameras are limited in the type of image that can be produced, for some situations they work well.[11]

High-end digital cameras look like the familiar 35mm camera. In fact most digital models consist of a camera back, storage unit, power supply and interfacing electronics. Because these cameras are so similar to their film counterparts, they offer the same types of options such as interchangeable lenses, shutter speeds, and aperture settings. The high-end camera uses resolutions that start at 1500 x 1000 pixels.[12]

Once the image has been captured, the digital information is stored for a short time in the camera. Because image resolution determines file size, the better the resolution the larger the file. File size limits how many images the camera can hold. Some models can download the image directly to the computer while other models have their own storage and viewing systems.

Digital Image

The digital image is a complex component. It is important to know the diverse factors that must be accounted for when creating an image that will reproduce well in print and its file size remain small enough for transmission.

In the printing trades the traditional photograph is known as a continuous tone image, or contone for short. Whether the image is grayscale or color, it is made up of an infinite number of shades and/or colors that blend together without any disruption. The traditional printing press cannot duplicate this variation in shade. The photographic image must be converted into a halftone. This process breaks the image into a series of dots. The size of the dots will vary depending on whether they fall in the lighter or darker area of the

image. This variation of dot size fools the eye into thinking it is seeing various shades.[13]

In order to produce a halftone, the continuous tone image is photographed through a flexible film screen. This halftone screen is made up of a given size dot pattern placed in a linear manner. The number of dots per inch determine the "halftone screen frequency" or "line screen." Screen frequency is expressed as lines per inch or lpi. Some representative screen frequency are 85 lpi, 133 lpi or 250 lpi. The higher the number of lines per inch will achieve more detail in the image.[14]

To establish a good image it is important to know the governing factors of the digital image. All are related and work together towards the end results of the final image.

The basic element used by the computer is the pixel. The image is composed of a grid or map of pixels. The more pixels that are used to describe the image, the better the resolution or the more detail the image will have. Pixels are noted by their frequency or pixels per inch (ppi) and by bit depth.[15]

Bit depth is the number of bits or information used to describe the bit. One bit of computer information is seen or read by the computer as either on or off, 0 or 1, or black or white. A simple black and white image is referred to as a bitmap image. If the image being used is made up of different shades of gray or grayscale, the bit depth is increased. Grayscale images use 8 bits of information per pixel which allows for 256 shades of gray. This number is ascertained by 2^8. Color images can use 8, 24 or 32 bits of information per pixel. As bit depth increases so does the size of the file.[16]

> "To determine a file size prior to scanning, the final size of the scanned image must be calculated in pixels and then multiplied by the pixel depth. First multiply the anticipated width of the scanned image by the anticipated length (in inches). Multiply this result by the image resolution squared(ppi):
>
> (Width x Length) x Image resolution^2 = Total Pixels

> The next step is to multiply the number of pixels that will make up the scanned image by the pixel depth (in bits).
>
> Total pixels x Pixel depth = Total bits
>
> Each color channel in a scanned image has a pixel depth of eight. RGB images, three color channels, have a pixel depth of 24, and CMYK images, with four color channels, have a pixel depth of 32. Most desktop scanners scan RGB.
>
> Custom file sizes are not measured in bits, but in bytes. One byte normally equals 8 bits. The final step in determining file size, then, is to divide the number of bits in the image by eight. 1,000 bytes is approximately 1 Kb; 1,000 Kb is approximately 1 Mb(1.024Mb)."[17]

There are several different types of resolution, when discussing the digital image. Resolution, overall, is the amount or density of digital information. The amount of information that a device can capture per inch or centimeter of the original image is called *input resolution. Image resolution* describes the total amount of information a digital image can have and is expressed in pixels. For example, a digital camera may offer two resolution options: 640 x 480 as a high resolution and 320 x 240 as a standard resolution. *Output resolution* is the number of horizontal and vertical dots per inch (dpi) an output device can produce. Many output devices have the capability to print continuous tone and/or halftone. If printing to a device using halftone reproduction methods, it is necessary to know what screen frequency will be used.[18]

> "For scanning resolution, multiply your output resolution (line screen x 2) by the scaling factor you need–the output size divided by the input size. If you want to reproduce a 1" x 1.5" 35mm slide at 6" x 9" with a 150-line screen:
>
> Line screen x 2 x (output dimension divided by input dimension)=Scanning resolution
>
> 150 x 2 x (6/1) = 1,800 (dpi)"[19]

If the images within the document are to be of acceptable quality and still maintain a file size that is small enough to transmit, the the person producing the document must be aware of how the images should be captured. By knowing these few facts about digital images, it should not be hard to incorporate high quality images.

Telecommunications

The mid 1800s saw the invention of telegraph and telephone communications. For the first time a person was able to communicate over long distances. Those inventors today would be in awe at the changes their inventions have brought about.[20]

As a person speaks, air is carried over the vocal chords causing sound waves to be produced. These waves are carried over the air to another persons ear, in which the sound waves enter causing the eardrum to vibrate. This produces a signal to the brain which then interprets the distinct sounds.[21]

Some of the same principles apply to the working of the telephone. The telephone mouthpiece has a diaphragm which vibrates as a person speaks into the telephone. The movement of the diaphragm causes an electrical current to form.

> "Electricity moves through telephone wires in much the same way as sound waves move through the air. In the case of electricity, electrons bump against other electrons, sending their energy from one end of the wire to the other. Speech is transmitted by these electrical waves with the electricity in the wires vibrating in the same pattern as the sound waves."[22]

The receiver also has a diaphragm that vibrates as the electronic signal is passed through an electromagnet. It duplicates the sound waves that were produced at the other end of the line.[23]

In the early sixties, digital phone transmission was developed. With the development of digital transmission came the ability to transmit voice, data and video signal over the telephone lines. As computers became more common, it was obvious that there was a need for computers to interact with computers in other locations. A modulator-demodulator or *modem* was invented to interface between the computer and telephone.[24]

Today telecommunications are merging with other technologies in this rapidly growing field. Tomorrows' telecommunications will probably include computers, television, consumer electronics, publishing and information services all combined into one service. The use of wireless communication devices such as pagers, cordless phones and cellular phones is on a steady increase. It was estimated that in 1996 the number of cellular phone users would top 30 million.[25]

Cellular telephone service allows for a mobile person to connect to a direct-dial telephone service by using radio transmission through a personal communications device. A geographic region is divided into cell sites with each site ranging from 1–12 miles in radius. Equipment to switch, transmit and receive calls to or from any mobile unit is located within each cell. A central mobile telephone switching office (MTSO) works to network the system together. If the signal level drops to low as the mobile unit moves from one cell to another, the MTSO looks for closer cell site and hands off the call to the next cell. This operation takes place so rapidly that the caller is not aware it is happening.[26]

Cellular transmission works well in populated areas because there are many cell sites available to the caller. This system however, does not work well in less populated or rural areas. A new technology is being developed by merging cellular and satellite communications together. In this system, calls are relayed through a series of low orbiting satellites.[27]

Satellites have been used for communications since 1959, when President Eisenhower relayed a recorded Christmas greeting around the world. Satellites are placed in "geostationary" or "geosynchronous" orbits around the earth. A signal from the earths surface is beamed or transmitted to the satellite through a ground station. The signal can transmit voice, data, video or a combination of information. The signal is either bounced to the user or receiving station or is transmitted to another satellite that is closer to the end source.[28]

> "Receiving equipment on the ground has three basic components. An antenna shaped like a 'dish,' which collects and focuses radio waves into a funnel, called a feed horn, which pipes these signals to an amplifier. Once amplified, the signals are converted into the required usable format such as television signals, voice or computer data."[29]

Satellite transmission is by far the superior means of transmission. It is also still the most expensive.[30]

Telecommunications continues to grow at a rapid rate. More consumers are willing to use the new communications technologies being developed. As production and acceptance of these devices continues to climb, the cost for using these devices will drop and more consumers will be able to afford them.

Digital Presses

Digital printing is a term that has grown out of the computer industry. Its origins come from the need to place information from the computer onto paper. Traditional printing methods are still available, but new methods of putting images on paper have been developed and continue to grow and change.[31]

In the mid thirties Chester Carlson invented the process known as xerography. It is a process that uses electrical charges, to attract toner which is then attached to the paper surface by a heated roller, to produce a printed image. This technology is the basis for the copier industry. Out of this technology has grown the laser printer, color copier, and the laser color printer.[32]

The definition of digital printing, according to Noel Jeffrey, is the production of printed materials directly from digital information residing in an electronic file on the computer. Materials no longer mean just paper, but a wide variety of surfaces such as film, fabric and even metal. Digital printing has even changed the way printers do business.[33]

As part of their makeup, the digital printer can be networked so it can interface with outside users. Networking allows for access from the same room, the same building, across the street or across the county. By accessing a digital printer through a network, control over the parameters of the job can be set external to the printer. Some systems are limited to black and white while others can produce full color. Job size and makeup can vary with as many choices as are available for each system.[34]

Endnotes for Chapter 2

[1]Howard M., Fenton, and Frank J. Romano. *On Demand Printing: The Revolution in Digital and Customized Printing.* (Pittsburgh, PA: Graphic Arts Technical Foundation, 1995), 117–125.

[2]Gregory A. Baxes, *Digital Image Processing: Principles and Applications.* (New York: John Wiley & Sons, Inc., 1994), 4.

[3]Robert J. Cone, *How The New Technology Works: A Guide to High-Tech Concepts.* (Phoenix, AZ: Oryx Press, 1991), 93.

[4]Ibid., 94.

[5]Michael Stoudt, Ph.D., *Image Quality: Don't Get Caught in the Numbers Game!* http://www.xplor.org/pubs/xploration/spring96/MStoudt.html.

[6]Carl Sesto, *The Macintosh Designer's Guide to Digital Imaging: Controlling Black and White and Color Output.* (New York: Wiley Computer Publishing, John Wiley & Sons, Inc., 1996), 36–37.

[7]David D. Busch, *Digital Photography.* (New York: MIS: Press, 1995).

[8]Ibid., 19.

[9]Ibid.

[10]Ibid.

[11]Ibid.

[12]Ibid.

[13]Noel Jeffrey, *Digital Printing: A Guide to the New World of Graphic Communications.* (Torrance, CA : Micro Publishing Press, Inc., 1996), 19–20.

[14]Emil Ihrig, and Sybil Ihrig, *Scanning the Professional Way.* (Berkeley, CA: Osborne McGraw-Hill, 1995), 101.

[15]Carl Sesto, *The Macintosh Designer's Guide to Digital Imaging: Controlling Black and White and Color Output.* (New York: Wiley Computer Publishing, John Wiley & Sons, Inc., 1996), 37.

[16]Ibid., 20–21.

[17]Frank J. Romano, *Pocket Guide to Digital Prepress.* (Albany, NY: Delmar Publishers, 1996), 183.

[18]Emil Ihrig, and Sybil Ihrig, *Scanning the Professional Way.* (Berkeley, CA: Osborne McGraw-Hill, 1995), 90–93.

[19]Frank J. Romano, *Pocket Guide to Digital Prepress.* (Albany, NY: Delmar Publishers, 1996), 193.

[20]John G. Nellist, *Understanding Telecommunications and Lightwave Systems: An Entry-Level Guide.* (Piscataway, NJ: IEEE Press, 1996), 3.

[21]Ibid., 11–12.

[22]Ibid., 11.

[23]Ibid., 10–12.

[24]Ibid., 4.

[25]Ibid., 98–102.

[26]Ibid., 98–100.

[27]Ibid., 101–103.

[28]Robert J. Cone, *How The New Technology Works: A Guide to High-Tech Concepts.* (Phoenix, AZ: Oryx Press, 1991), 109.

[29]Melene Follert, *Data Transmission for the Graphic Arts Industry.* (Arlington VA: National Composition Association and GAMA, 1987), 15.

[30]Ibid., 14.

[31]Noel Jeffrey, *Digital Printing: A Guide to the New World of Graphic Communications.* (Torrance, CA : Micro Publishing Press, Inc., 1996), 8.

[32]David Bergsland, *Printing In A Digital World.* (Albany, NY: Delmar Publishers, 1997), 438–439.

[33]Noel Jeffrey, *Digital Printing: A Guide to the New World of Graphic Communications.* (Torrance, CA : Micro Publishing Press, Inc., 1996), 8.

[34]Howard M., Fenton, and Frank J. Romano. *On Demand Printing: The Revolution in Digital and Customized Printing.* (Pittsburgh, PA: Graphic Arts Technical Foundation, 1995), 117–120.

Chapter 3

Review of Literature

Many of the technologies that the graphic arts industry uses today are a result of the efforts made by National Aeronautics and Space Administration (NASA) during the space exploration programs that began in the sixties.

> "The roots of significant achievement in digital image processing can be traced back to the early 1960s. The United States, through the National Aeronautics and Space Administration (NASA), was energetically pursuing its lunar science program. NASA's interest was in characterizing the lunar surface to support the upcoming Apollo manned lunar exploration program.
>
> The Ranger program was established, in part, to image the lunar surface, relaying the pictures to earthbound scientists for evaluation and composition into lunar maps. After four previous Ranger missions, during which the video equipment failed to function, Ranger 7 returned the first video image from the moon. Ranger 7 went on to return thousands of images in what became a very successful mission.
>
> The original Ranger images were created and transmitted to Earth in an analog signal form. They were recorded and then converted to a digital form. Subsequent digital processing of the images by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, was used to correct various camera geometric and response distortions successfully. This digital image processing

> was carried out at significant expense using large mainframe computers. This processing of Ranger 7 imagery used the digital computer into the image processing world.
>
> . . . . . .
>
> From the 1960s through today, the evolution of the digital computer has certainly been largely responsible for enabling the proliferation of digital image processing applications. Costly mainframe computers are no longer a requirement of the digital image processing equation like they were in the 1960s. The advent of microprocessors, leading to the personal computer, has allowed stand-alone digital image processing applications to become viable."[1]

These historical achievements in digital imaging processing have brought about changes in a wide variety of applications. In the printing industry it has influenced the following applications:

> "*Document Processing* Acquisition and processing of documents and drawings have helped to automate many industries that were classically paper-driven, such as banking (check processing) and insurance-claim processing.
> • Scanning, archiving, and transmission—converting paper documents to a digital image form, compressing the image, and storing it on magnetic or other media for archiving.
> • Document reading—automatically detecting and recognizing printed characters so that documents like bank checks, tax forms, and so forth can be intelligently processed by computer.
> *Photography* Digital image processing techniques have augmented and, in some cases, replaced methods used by the photographer for image composition and darkroom processing.
> • Image enhancement—various techniques for improving the visibility or artistic rendering of features that are not acceptable or clear in the original image, such as contrast balancing, edge

> sharpening, color balancing, or retouching of defects.
> • Multiple-object scene compositing—adding and subtracting objects to and from a scene to create illusions that did not originally exist.
> • Special effects—warping, blending, and other visual effects to cover existing imagery into new visual forms.
> *Publishing/Prepress* The desktop publishing and prepress industries use digital image processing techniques to enhance and lay out digital images for publication. Most publications use digital image and typography techniques.
> • Image enhancement—various techniques for improving the visibility or artistic rendering of features that are not acceptable or clear in the original image, such as contrast balancing, edge sharpening, color balancing, or retouching of defects.
> • Layout compositing—mixing of image, text, and graphical elements into final film suitable for printing.
> • Color separation—creating cyan, magenta, yellow, and black film separates for the four-color printing process."[2]

Video cameras were first used to capture images that could be changed to a digital format. Up until the 1990s images used in computer photo manipulation were those that were either captured from video and digitized or images that had been scanned from hard copy photographs. The digital camera started out as a still-video camera. The development of CCD technologies have made it possible for the digital camera to develop into the camera that is used today.[3]

> "What made today's camcorders, still-video cameras, and flatbed scanners possible was the development of electronic image-capture devices. First there were image tubes for TV cameras and remote sensing applications. In the 1970s, the charged-coupled device (CCD) appeared and eventually replaced most of the image tubes, except for a few specialized applications. Image tubes are still found in applications where low-light imaging and light

> intensification is needed. CCD devices cannot, in most cases, amplify light."[4]

> "Digital camera systems are beginning to appear. Most of these systems have the same CCDs found in analog still-video cameras, but the picture information is converted in the camera to a digital signal and stored in either a RAM or ROM memory."[5]

Once the image has been captured, it can be downloaded to the computer. With the assistance of computer software, the image can be manipulated, enhanced and/or retouched. Because there is an absence of film, the time needed for film processing is gone. The image, once finished, can be placed directly into the page layout. The document now in its finished state is ready to transmit to the digital print center. Using a modem and a cellular phone will allow the connection to a remote location.

> "Information is produced and transmitted over the telephone network as electrical signals. These signals have two forms: analog and digital. Analog signals are continuous and can be thought of as electrical voltages that vary continuously with time. Digital signals are a series of on/off pulses . . . .
>
> Transmission in the telephone network was completely analog until 1962, when digital transmission was introduced. Some long distance lines and most customer loops are still analog because of the tremendous investment that telephone companies have in this equipment.
>
> However, due to the new competition in the telephone industry and the introduction of new technologies, this situation is changing rapidly, as we will see in the following sections."[6]

> "Cellular mobile telephone service is a system for providing direct-dial telephone service to mobile vehicles or personal communications devices, by using radio transmission.
>
> Mobile telephone service has always been very popular with

> business customers, but its growth has been restricted due to the limited number of radio channels available. An entirely new approach utilizing a cellular concept was developed to provide high-quality mobile service for more customers at an affordable cost. Cellular radio has proven to be one of the fastest-growing technologies in the world."[7]

Digital printing is a modern concept that allows printing to be preformed in a short run capacity. Using traditional printing methods was far to costly to consider small run numbers. Customers, using traditional methods, in the past have saved money by purchasing large quantities. Other problems accompanied buying large quantities, such as storage or changes that could occur over the span of the quantity. With digital printing came new ideas of how and when a document could be produced.

> "In an oversimplification of the on-demand process, the client supplies electronic files or camera-ready materials and specifies how many copies of the publication will be needed. The printer produces the publication directly from the disk or camera-ready artwork and delivers it within a specified timeframe.
>
> There are many aspects to the process that make it more than simple. With short-run work, it is necessary to automate the job submission so that all information about the job accompanies the actual electronic file. This is only one aspect of on-demand that escapes potential users. Short runs imply that more jobs will be passing through a facility, with average runs of under 1,000. This will force the modification of workflow and billing procedures. Currently there are three specific on-demand strategies in our industry—on-demand printing, distributed demand printing, and on-demand publishing.
>
> Except for rare occasions when traditionally prepared and printed short runs are fast and economical, most of the time the expression 'on-demand' means that the data is stored and printed in electronic form. It doesn't have to be an electronic file, but

> generally it is a digital file which facilitates the efficacy of the short run. (Remember, any reproduction process can be on-demand or short run.)
>
> The second strategy is known as distributed demand printing. Unlike the general concept of demand printing, the distributed demand printing workflow requires that the electronic files can be transmitted to other locations, printed, and distributed locally. These publications can then be stored, printed, and shipped locally as needed.
>
> This an implementation of the distribute-and-print philosophy as opposed to the traditional print-and-distribute philosophy. The traditional long-run printing strategy is to print large volumes in a central location and then ship them both long (nationally) and short distances (regionally). Decentralization does reduce shipping costs but does not eliminate storage and distributions costs. Combining on-demand printing with decentralization produces the best results.
>
> The third general strategy is demand publishing in which the data is stored in paginated form and transmitted for immediate printout. Large volume magazines do this–which allows them to provide regional inserts. Portable Document Formats, such as Adobe Acrobat or No Hands Common Ground, are being used to distribute the paginated and print-ready page and document files."[8]

Distributed on-demand printing is the perfect technological partner to unite with wireless transmission techniques. This will allow a person in any geographic location to communicate with the printer in order to complete the document cycle. Wireless transmissions are still in their infantile state. These technologies are forecasted to escalate in popularity and availability over the next few years.

> "Transmitting data at speeds of gigabits per second over fiber optics will be a reality in the near future. However, data transmission will eventually move toward wireless nets, with wireless networks implemented as either LANs, MANs, or WANs. By

providing coverage for a building, city, region, or even a nation, wireless-network technology makes it possible for users to stay connected while still on the move.

Wireless data networks and services are poised to revolutionize mobile computing. As companies and workers become more mobile, and as routine office tasks are outsourced to offsite locations, the value of wireless communications becomes strikingly apparent. Wireless data transmission uses packet switching, which entails breaking messages into hundreds of small packets, each containing the intended address of the information. These packets are routed to the addresses based on the availability of open circuits, in tandem with other messages. This scheme results in drastically reduced waiting time.

The biggest limitation of wireless networks is the range and signal strength of transmitters. There are also problems of interference and limited bandwidth. Other complications that current users encounter include the difficulty of telling why transmissions are unsuccessful, and making wireless data transmission work from inside either a parked or moving vehicle. Wireless transmission will require more development than wire-line transmission. Coverage, error management, and the cost of wireless data distribution will improve over time. This technology allows users to communicate regardless of their location, as a physical transportation medium (cable) is not needed. This is an important feature because in the future, portable computers equipped with receiving software that allows connection to the information highway could be just as common as the telephone."[9]

Endnotes for Chapter 3

[1]Gregory A. Baxes, *Digital Image Processing: Principles and Applications.* (New York: John Wiley & Sons, Inc., 1994), 5–7.

[2]Ibid., 8–10.

[3]John Larish, *Digital Photography: Pictures of Tomorrow.* (Torrance, CA: Micro Publishing Press, 1992), 18.

[4]Ibid.

[5]Ibid., 32.

[6]John G. Nellist, *Understanding Telecommunications and Lightwave Systems: An Entry-Level Guide.* (Piscataway, NJ: IEEE Press, 1996), 14.

[7]Ibid., 122.

[8]Howard M., Fenton, and Frank J. Romano. *On Demand Printing: The Revolution in Digital and Customized Printing.* (Pittsburgh, PA: Graphic Arts Technical Foundation, 1995), 7–8.

[9]Frank J. Romano, *Pocket Guide to Digital Prepress.* (Albany, NY: Delmar Publishers, 1996), 159–160.

Chapter 4

Statement of the Problem

Is it possible that a person with some knowledge of computers and peripherals, desktop publishing, and digital photography can transmit documents using cellular communications from a field location to a digital press to produce a finished product?

Objective: To produce a finished document by transmitting a digital document to a digital print center from a remote location using portable computer equipment and cellular communications.

Goals: In order to complete the finished document, using the method described above, a person should be able to:

- capture images using a digital camera
- compile a sample document using the digital images
- transmit digital information via cellular communications
- output an acceptable product
- ascertain what problems can arise

Chapter 5

Methodology

Experimental Design of the Study

This project required the use of portable computer equipment, the standard publishing programs, a digital camera and a cellular phone. Since the project required working with photographic images, a fast processor and large amounts of RAM were needed in the computer. The equipment was chosen to fit the specifications that met the needs of the project.

The problem will be to test transmission to see:

1. if the file will transmit from the computer through the modem and cellular phone to the digital print center.
2. how long a given file size (preferably under 1 Mb) will take to transmit.
3. if the image quality is influenced.

Instrumentation and Equipment Used

The equipment used in this study included:

Macintosh Powerbook 5300CS, 32MB RAM, 750 MB HD

28.8 Global Village PCMCIA Fax/Modem

Kodak DC120 Digital Camera

Zip Drive

PC Laptop Computer

Motorola Elite Cellular Phone

Software:

Adobe PhotoShop

Quark XPress

NetScape

Xerox Launch

Kodak Picture Transfer

The Process

Before beginning it is important to consider how the final document will be output. There are several questions to calculate: On what type of digital printer will the output be produced? Does it require halftone images or continuous tone images? Will the output be black and white or color? What is the final addressability of the device? How should the file be saved to be compatible with the output device? With all these parameters in place, the document can best be prepared for optimum output. Also keep in mind that file size, image quality and transmission time are all related.

The parameters for this job are:

Digital Printer–Docutech 9500

Images–Continuous tone

Output–Black and white

Final Resolution–600 dpi

File format– PostScript

The first step was to collect images for the test document. A Kodak DC120 Digital camera was used. The CCD Addressability is 850 x 984 pix which delivers 1280 x 960 pixels and uses 24 bit color depth. There are four image quality settings: uncompressed, best, better and good. The uncompressed setting was used. This allowed 12 images to be taken. The camera has a macro lens option that will take pictures from 19 to 8 inches. Its normal lens uses an autofocus from 19 inches to infinity. When using the macro option, care must be taken to measure the space from the object to the lens to make sure that the image is in focus. The camera features an LCD color display that allows the image to be view instantly. Unwanted images can be deleted immediately.

The images were composed so that different image problems could be checked. Several close up images were taken using the macro lens. This would establish how well the camera records small detail while maintaining a quality image. Several landscape images with architectural structures were included. These images would show line distortion. A low light image was taken to see how well detail records in the shadow areas of the image.

Once the images were taken, they were downloaded to the computer. For this part of the process, the computer system consisted of a PC laptop computer, a Zip drive and used Kodak's Picture Transfer software for downloading the images to the computer. It took approximately one hour to download 12 images. Each image file was 3.52 MB, RGB, 72 ppi and measured 17.75" x 13.625".

The final output device was a Docutech 9500. This required images to be continuous tone black and white. The captured images had to be converted into usable files that were compatible with the output device. Using a Macintosh Powerbook 5300 with 32 MB of RAM, a 750 MB hard drive with a Zip drive attached to it, the images were opened in Adobe PhotoShop. Four images out of the 12 were selected to use in the test

document. Image 1 (Building), Image 2 (Garden), Image 3 (Iris) and Image 4 (Necklace). Each image had to be converted from RGB to Grayscale. The image resolution also had to be changed from 72 ppi to 300 ppi. In the process of making this alteration it reduced the physical image size from 17.75" x 13.625" to 4.25 x 3.125". This also influenced the file size, changing it from 3.52 MB to 1.17 MB.

Next enhancements were made to the images so each image would print to its optimum capacity. When the images were converted to black and white, they appeared dark in the shadow area. The shadow areas were lightened so that more detail showed. Unsharp masking was used on Images 2, 3 and 4. The parameters used in unsharp masking were: 50% Amount, 5.0 Radius and 5 Threshold. Image 3 had enhancements performed in the background of the image to give it more contrast in the final image. When the enhancements were completed each image was saved as a TIFF file.

The page layout and text were then produced using the publishing software, Quark XPress. The test document would be a two sided brochure using one photograph on the front and three photographs on the inside. Two fonts were used. Pepita (Script face) and Adobe Caslon (Roman face). Limiting the font selection helped to control the final size of the file. The back of the brochure contained several elements that would be used in the evaluation of the transmitted document once it was produced on the digital printer. These elements included a script type set in white on a solid black background, a gray scale, a series of closely placed vertical and horizontal lines and a pie target.

The test document was printed to an HP Laser Printer to be used as a proof. This proof copy would be used as a comparison to the transmitted document. The test document was then saved to a PostScript file using the parameters setup by the Digital Publishing Center at Rochester Institute of Technology. This created a final file size of 4.4 MB.

For modem transmission, the computer had a 28.8 Global Village PCMCIA Fax/Modem card installed. Using a special cellular connection kit and Global Village software, the computer was attached to a Motorola Elite Cellular Phone. The wireless transmission of the test document took place in the park at Crittendon and East Squire Drive in Rochester New York.

Two transmission tests were made. In the first test, the digital printer was accessed through the internet. Using NetScape the Digital Publishing Center was activated by a net connection. Using on-screen directions, the test document was submitted. The transmission took 64 minutes to download to the server.

Later the document was retrieved from the server at the Digital Publishing Center and sent to the job manager on the Docutech. A proof was produced at the Docutech and checked. The test document had been sent to print head to head but was printing head to toe. A minor adjustment was made through the job manager and another proof was made. This time the pagination was correct and fifteen documents were printed.

The second transmission test involved using proprietary software. Using Xerox software "Launch" a direct link is made from the modem to the file server. The same test document was used. Launch takes the PostScript file and compresses it. It then logs on to the server and begins a download process. Once the file has been downloaded, it can be held or transferred to the job manager of the Docutech for printing. The final output was to a Docutech 9500 at Suttons' Printing in Grand Junction, Colorado.

During this test, a connection was made to the server and the job logged on. As the process began it would begin downloading but would then disconnect. This connection was tried many times with the most successful download being 9%. The process was never 100% successful and the file did not successfully transfer. Attempts were made to change the preferences within the software but this also was not successful. One

observance was that the cellular connection slowed the baud rate of the modem to 12.2. The technical support services at Launch were contacted for advice on the problem. Their theory discussed problems on the receiving end. It was possible that the version numbers of the software were not the same or possibly a wrong init stream was being used. When the baud rate was discussed, they explained that a rapid drop in baud rate would cause the system to disconnect. The receiving modem used a 33.6 baud rate and the PCMCIA Fax/Modem used a 28.8 baud rate but would drop to 12.2 with the cellular connection.

Chapter 6

Results

Is it possible that a person, with some knowledge of computers and peripherals, desktop publishing, and digital photograph, can transmit documents using cellular communications for a field location to a digital press to produce a finished product?

Test one shows that documentation can be produced from a field location with excellent results. In this test, using the internet as a means of connection to the digital print center, a completed transmission took place. The 4.4 MB test document file was transmitted at 12.2 baud rate and took 64 minutes to complete. The transmitted document which was produced on a Docutech 9500, was compared to the proof print which was produced on an HP LaserJet Printer. The image quality of the transmitted document was equal to or better quality than the proof print. This quality check can best be seen in the gray scale target found on the back of the test document. The transmitted copy produced on the Docutech shows distinct steps in the shadow densities of the scale. The proof print shows the last two steps of the scale merged as one. In comparing the photographic images, both documents show the same quality in the images.

With the success of test one the objective was met. To produce a finished document by transmitting a digital document to a digital print center from a remote location using portable computer equipment and cellular communications.

The methodology shows that each one of the goals set was achieved to reach the objective. Those goals were:

1. to capture images using a digital camera
2. compile a sample document using the digital images
3. transmit digital information via cellular communications
4. output an acceptable product
5. ascertain what problems can arise

Problems did arise during the testing. Test two was not successful. The connection between the portable equipment and the off site file server could not be maintained for complete download of the file. One complication, that may have influenced the experiment was that connecting the cellular phone to the modem slowed the baud rate of the modem from 28.8 to 12.2. This factor did contribute to longer transmission times which in turn cost more money. It may have also been a factor in test two, causing the connection to the file server to disconnect because of a fast drop in baud rate. Since test two was not successful, more investigation needed to be made into why there were problems with the transmission.

Reviewing the hypotheses, objective and goals it shows that this test has been successfully completed.

Chapter 7

Summary and Conclusion

High on a mountaintop, a biologist discovers a new species of plant. It is important to inform the scientific world of this discovery. Only a few years ago, the biologist would have spent a couple of weeks to bring together images and text to produce documentation of this find. Today this task can be preformed on site in a matter of hours using a portable computer and wireless communications to transmit that information to one or more digital presses for final output.

The sixties NASA space program helped to develop the digital image technologies that are used today. From this past has come the digital camera. This camera uses CCDs to capture digital images. The image information is held in storage until it is downloaded from the camera to a computer. The use of digital cameras has eliminated the need for film processing and printing, so that images can be used instantaneously.

In the early eighties personal computers became a popular tool to use in the business world. As the personal computer advanced the technology became faster and smaller. It wasn't long before computers were the size of a briefcase and could be used anywhere.

The use of computers also had an impact on the printing industry. Now typography, page layout, drawings and images can all be compiled on the computer. The entire

page can exist in digital form. Only one person is needed to complete the page composition.

The invention of the process xerography has lead to the results of digital presses. These printing devices take the digital information from the computer and produce hard copy. Printing is not limited to just paper. A variety of materials can be used in conjunction with a digital press. These presses also have the capability of printing color.

Telecommunications has also been influenced by computer technology. The modem was invented so that computers could communicate with one another. Digital information could be sent over the telephone lines to one or more locations.

As our society has become mobile, there has been a need for portable communications. The invention of cellular technologies has provided a mobile connection to direct dial telephone lines. A phone call can now take place anytime or anywhere services are provided.

Many technologies are merging to form new uses. Is it possible that a person with some knowledge of computers and peripherals, desktop publishing, and digital photography transmit documents using cellular communications from a field location to a digital press to produce a finished product?

Objective and Goals

The objective of this study was to produce a finished document by transmitting a digital document to a digital print center from a remote location using portable computer equipment and cellular communications. In order to achieve this objective the following goals were set and executed.

Goal #1: capture images using a digital camera.

Using a Kodak DC 120 digital camera 12 images were captured. This camera uses a CCD resolution of 850 x 984 pix which delivers 1280 x 960 pixels and uses 24 bit color depth. The uncompress quality setting was used. A variety of images were composed. The macro setting allowed for close up images to be taken. Each image file was 3.52 MB, RGB, 72 ppi and measured 17.75" x 13.625". The images were downloaded from the camera to disk using portable computer and Kodak Picture Transfer software. It took approximately one hour to download the 12 images.

The digital press required different parameters for the images. Using PhotoShop the images were converted from RGB to grayscale and 72 ppi to 300 ppi. These changes influenced the file size, changing it from 3.52 MB to 1.17 MB. The physical size of the image also changed from 17.75" x 13.625" to 4.25" x 3.125". Some enhancements were performed to help bring up more detail in the images. The files were then saved in TIFF format.

Goal #2: compile a sample document using the digital images.

The text and page layout were produced using Quark XPress. The test document was set up as a two sided brochure. Four of the digital images were incorporated into the layout. Once the document was completed a proof copy was made from an HP Laser Printer. This proof would be used for comparison to the transmitted document. The parameters of the output device required the document to be saved in a PostScript file format.

Goal #3: transmit digital information via cellular communications.

Two tests were performed for transmission of the digital information. Both test used cellular communications for the link between the computer and the digital press.

In the first test, NetScape was used to access the Digital Publishing Center at Rochester Institute of Technology through an internet connection. Using on-screen directions, the test document was submitted. It took 64 minutes to download the file to the server.

In the second test, proprietary software, Xerox Launch was used to make a direct link between the computer and the file server at Suttons' Printing in Grand Junction, Colorado. The link was made but the download of the file was never completed.

Goal #4: output an acceptable product.

At the Digital Publishing Center the document was retrieved from the server and sent to the job manager on the Docutech. A proof was produced and checked. The pagination was not correct. Minor adjustments were made through the job manager and rechecked. With the pagination correct, fifteen documents were printed.

Since the second transmission was not completed a final product could not be produced.

Goal #5: ascertain what problems can arise.

It is obvious looking at the second test that not all transmissions are successful. Problems can occur. It was noted that during the second test, transmission through the cell phone slowed the baud rate to 12.2. This may account for the unsuccessful results. Some problems such as pagination can result, but can be changed at the output device. The user should be prepared that problems can occur.

Results

The transmission of test one produced a completed document. The transmitted document showed as good a quality product as the proof document. The objective of the study was met when a finished document was produced by transmitting that digital information to a digital print center from a remote location using portable computer equipment and cellular communications.

Recommendation for further study

Digital presses now include color output. Many problems can arise when working with color. Files containing color information are much larger than black and white files. This will create longer transmission times. Additional studies could be made on how transmission affects color output.

Connection to the cellular phone slowed the baud rate of the modem from 28.8 to 12.2. Further investigation could be made into what happens when the modem is connected to a cell phone. Does this cause problems with a direct connection to a file server? Is there a specific baud rate the file server needs to stay connected?

Files that include images tend to be very large. If the document was lengthy it would create extremely large file sizes. If the document contained color it would also increase the file size. Is there a better file format to use when saving the file? Could PDF files be used? Would PDF create a smaller file size? Would PDF make it easier for transmission of these files?

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Appendices

Appendices A

Proof of Test Document

COMPUTERS HAVE CHANGED THE WAY OUR society works. Everyday life is somehow effected by a computer. It has changed the way many industries do their business. The business world is now a global community.

The Graphic Arts industry has been impacted by these changes. With computers, now documents are found in digital form. Instead of being hand prepared, they are compiled within the computer realm. By using modems, these documents can travel from one location and be printed at several different locations, even world wide.

Traditional printing methods have advanced to digital formats also. On-demand printing is one of the leading technologies in the printing industry. No longer is on-demand a black and white process as color digital presses have entered into the arena.

Photography also has recently gone to digital format. It is no longer necessary to go through the stages of having images processed and printed to hard copy. With digital cameras photographs can go straight from camera to page layout.

As the computer evolves, it is also becoming more portable so that our mobile society is not tied into one location. Along with this mobility, there is a strong trend in communications that are also mobile. Wireless technologies are advancing at a rapid rate to keep up with customer demand.

By combining these emerging technologies, it should be possible for a person working or living in a remote location to produce and distribute printed documents to several locations at one time.

Thank You

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Professor Barbara Birkett
Tracy Glassman
Suttons' Printing

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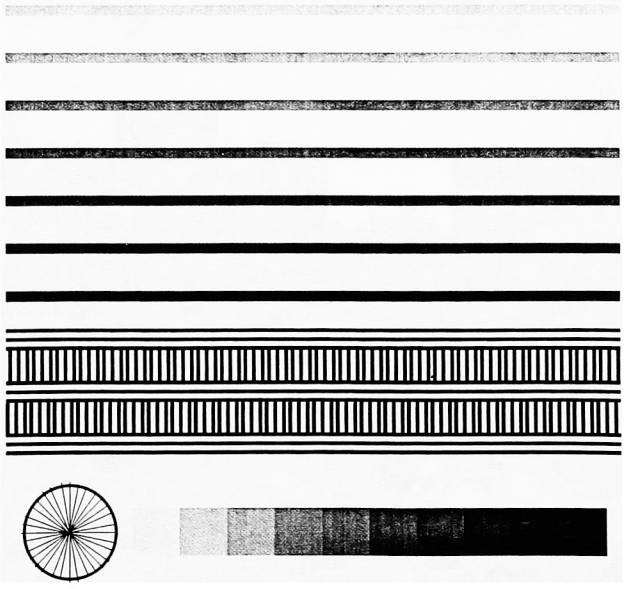
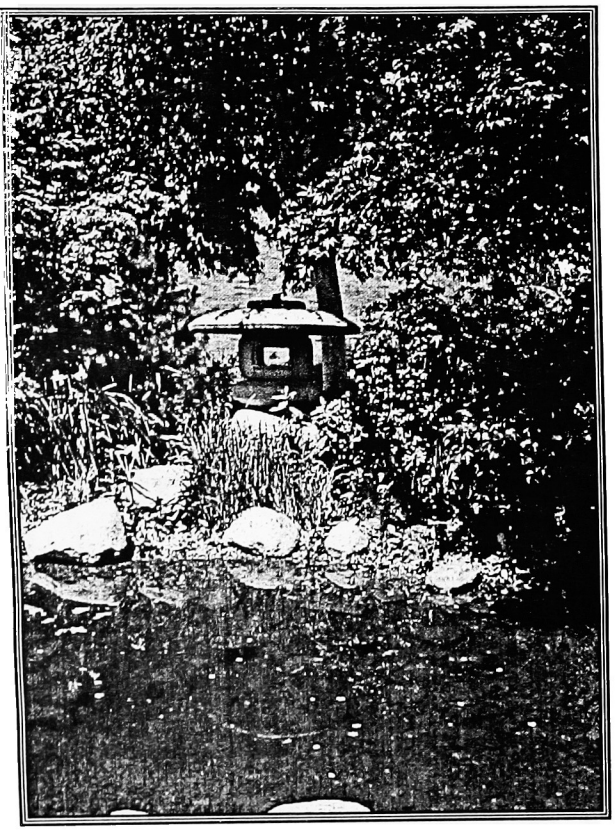
Brenda Beden
July 1997



An Experiment in

Wireless Documentation



How Was It Done?

These images were taken with a Kodak DC 120 Digital Camera. They were downloaded to an IBM Laptop and stored on a Zip Disk.

A Zip Drive was connected to a Macintosh PowerBook.The images were converted and retouched with Adobe Photoshop and placed in position on the page in Quark Xpress.

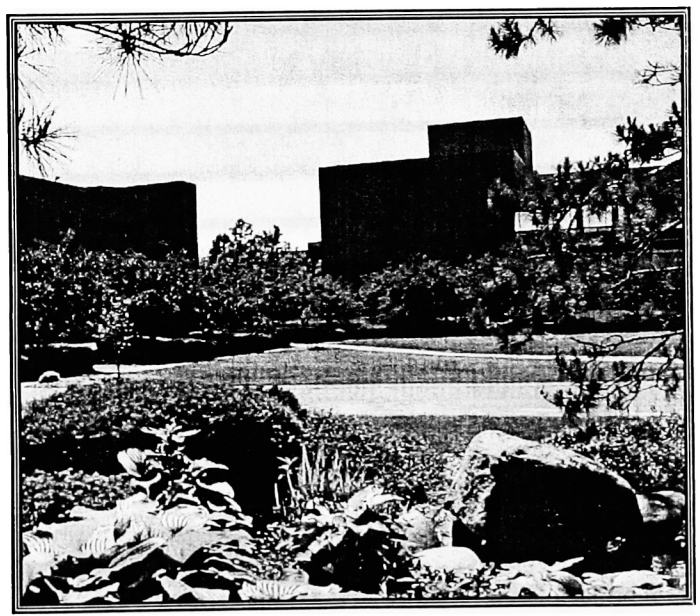
Once the document was completed it was saved into a PostScript file. The file was sent via cellular phone over the Internet and downloaded to the file server for the Docutech.

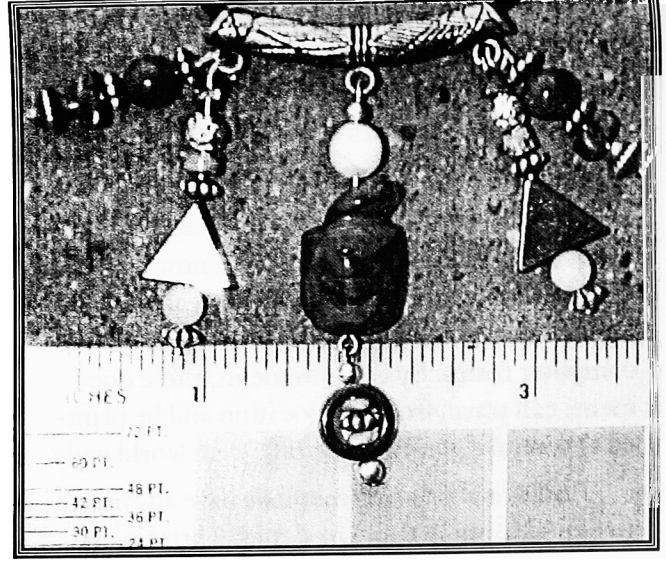
The document is then ready to be printed and distributed.

What is Wireless Documentation and Who Will Benefit?

WE HAVE MOVED FROM PREPARING DOCUMENTS by hand to preparing them on the computer. In order to produce a document a person sets the type, positions it on the page, produces drawings and/or tables and can even manipulate photographs. With the invention of digital photography, time is not needed for processing and printing of photographs. Images now can go straight from the camera to the digital page. The entire document can exist in digital form.

The modem allows transmission of information from one location to another. Once the document is in digital form it can be sent to one or several different locations, what ever the need may be. By using the internet, the document producer can even shop for a digital printing center in the location the document will be sent. Most printing centers use the internet as a way of connecting with customers.





On-demand printing, another new technology, will make remote site printing possible. On-demand printing most often utilizes a Xerox Docutech. This high speed printer produces laser quality copies. One method of producing copies is by using a network which allows a person outside the printing facility to transmit, via modem, the document information to the Docutech. This function also allows copies to be sent to multiple locations if necessary. The digital document information is stored until output is needed. This means whatever is produced at the off site location can be sent without ever having to set foot in the print shop to have copies made.

Advertising and sales promotions indicates that all of this technology is in place and working well. If we can produce documents in normal surroundings then we can assume that the same task can be done using portable hardware and cellular phones. If this is so, that would mean that documentation could take place anywhere. For professions working in remote environments, like archaeologist, geologist and environmentalists, this would mean that information could be sent out at greater speeds.

Appendices B

Transmitted Test Document

COMPUTERS HAVE CHANGED THE WAY OUR society works. Everyday life is somehow effected by a computer. It has changed the way many industries do their business. The business world is now a global community.

The Graphic Arts industry has been impacted by these changes. With computers, now documents are found in digital form. Instead of being hand prepared, they are compiled within the computer realm. By using modems, these documents can travel from one location and be printed at several different locations, even world wide.

Traditional printing methods have advanced to digital formats also. On-demand printing is one of the leading technologies in the printing industry. No longer is on-demand a black and white process as color digital presses have entered into the arena.

Photography also has recently gone to digital format. It is no longer necessary to go through the stages of having images processed and printed to hard copy. With digital cameras photographs can go straight from camera to page layout.

As the computer evolves, it is also becoming more portable so that our mobile society is not tied into one location. Along with this mobility, there is a strong trend in communications that are also mobile. Wireless technologies are advancing at a rapid rate to keep up with customer demand.

By combining these emerging technologies, it should be possible for a person working or living in a remote location to produce and distribute printed documents to several locations at one time.

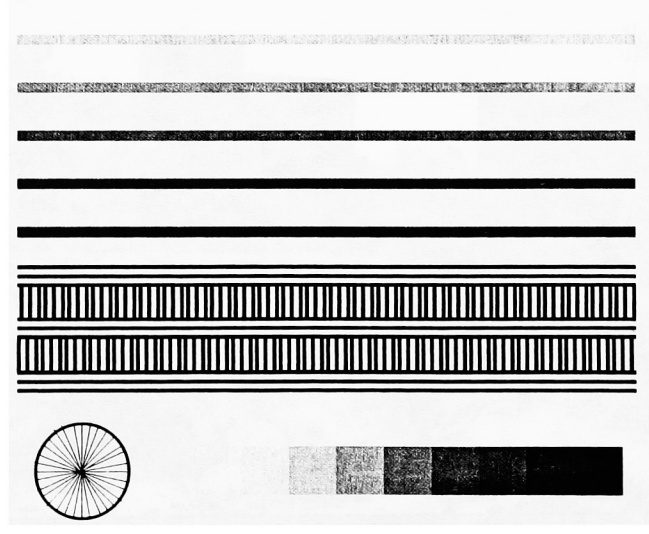
Thank You

Thanks to all who helped make this project possible. With out you it could not have happened. Your input, support and suggestions were invaluable.

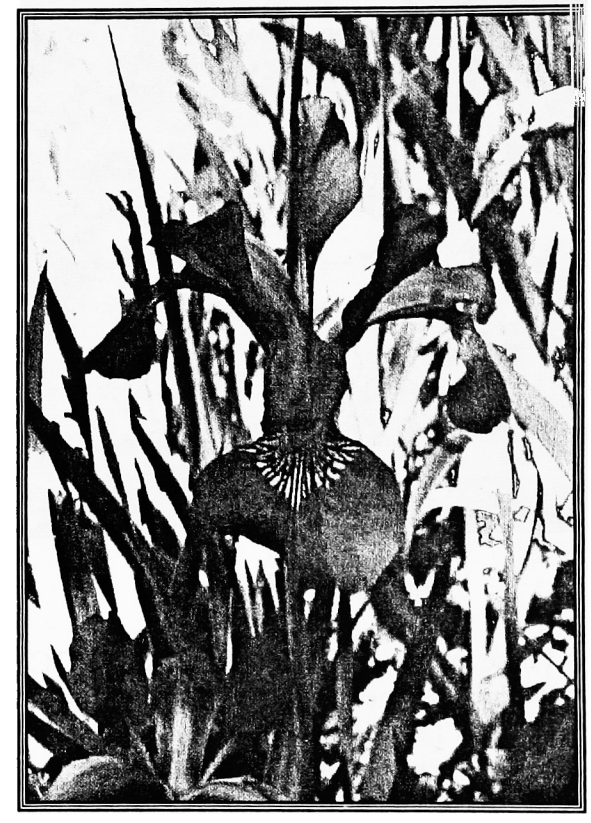
A most special thanks to:
Gary Beden
Professor Frank Cost
Professor Barbara Birkett
Tracy Glassman
Suttons' Printing

Produced as part of a Masters Thesis project at
Rochester Institute of Technology,
Rochester, New York.

Brenda K. Beden
July 1997



An Experiment in



Wireless Documentation

How Was It Done?

These images were taken with a Kodak DC 120 Digital Camera. They were downloaded to an IBM Laptop and stored on a Zip Disk.

A Zip Drive was connected to a Macintosh PowerBook. The images were converted and retouched with Adobe Photoshop and placed in position on the page in Quark Xpress.

Once the document was completed it was saved into a PostScript file. The file was sent via cellular phone over the Internet and downloaded to the file server for the Docutech.

The document is then ready to be printed and distributed.

What is Wireless Documentation and Who Will Benefit?

WE HAVE MOVED FROM PREPARING DOCUMENTS by hand to preparing them on the computer. In order to produce a document a person sets the type, positions it on the page, produces drawings and/or tables and can even manipulate photographs. With the invention of digital photography, time is not needed for processing and printing of photographs. Images now can go straight from the camera to the digital page. The entire document can exist in digital form.

The modem allows transmission of information from one location to another. Once the document is in digital form it can be sent to one or several different locations, what ever the need may be. By using the internet, the document producer can even shop for a digital printing center in the location the document will be sent. Most printing centers use the internet as a way of connecting with customers.

On-demand printing, another new technology, will make remote site printing possible. On-demand printing most often utilizes a Xerox Docutech. This high speed printer produces laser quality copies. One method of producing copies is by using a network which allows a person outside the printing facility to transmit, via modem, the document information to the Docutech. This function also allows copies to be sent to multiple locations if necessary. The digital document information is stored until output is needed. This means whatever is produced at the off site location can be sent without ever having to set foot in the print shop to have copies made.

Advertising and sales promotions indicates that all of this technology is in place and working well. If we can produce documents in normal surroundings then we can assume that the same task can be done using portable hardware and cellular phones. If this is so, that would mean that documentation could take place anywhere. For professions working in remote environments, like archaeologist, geologist and environmentalists, this would mean that information could be sent out at greater speeds.

Appendices C

Users Guide

Users Guide

Printing from a remote location using wireless communications

A guide for setting up a system to print from any location using wireless communications connected with off-site digital presses.

Part of thesis requirements

Brenda K. Beden

November, 1997
Rochester Institute of Technology

Introduction

Computers continue to change the way people perform their daily business. These technological changes have dramatically influenced the Graphic Arts industry. Printed documents that once took weeks to complete can now be finished in a day or two. Some occupations require personnel to perform assignments in remote destinations, away from the conveniences of the office. For these employees it has meant countless hours of travel to complete and distribute printed documents. Now it is possible, by the use of portable computer equipment and wireless communications, to produce printed documents from those faraway locations.

Although this process may seem simple, it is not a procedure that should be taken on by a computer novice. It is important that the person who sets up and uses or supports this system have a good understanding of their computer system, software and what technical support is available to them.

The system should be set up prior to going on location to check that all components work properly together and there are no bugs in the system. Nothing could be worse than being miles away from civilization to find out you are missing one necessary component to complete the process.

In this process, a document will be compiled in a remote location and transmitted to an off site digital press using wireless communications. The document may contain photographs, drawings and/or tables as part of the information. A digital camera will be used to obtain the photographic images. Since this type of image does not require processing, images can be directly downloaded from a camera to the computer. Image manipulation software can be used to enhance the image for output. Graphic software can be used to complete drawings and/or tables. All of this information can then be placed on the page using page layout software.

Once the document is completed it is saved into some kind of file format, like a PostScript file. Either using a direct link to a digital printer or using an internet link, the document can then be downloaded to the file server of the digital printer(s). This function can be completed to one or several different locations. From the digital printer, copies of the document can be made and distributed to the end user.

On the following pages you will find an explanation of what type of equipment to research and a place to make notations for comparison of systems and costs. At the end of the guide is a summary sheet that provides a place for final decisions and costs.

Equipment Needs

Telecommunications

At this time the weakest link in the system is the telecommunications. It is still in early stages of development and has limited capabilities. The first step is to find out what telecommunication options are available for the region you will be working in. Satellite technologies will be more costly, but provide a cleaner and more secure connection. Cellular technologies are less costly, and may be limited in sparse populations. Keep in mind that cellular connections are not secure.

Telecommunications: **Cost**

Satellite _____ ❑ _____

_____

_____

_____

_____

_____

Cellular System _____ ❑ _____

_____

_____

_____

_____

_____

Device _____ ❑ _____

_____

_____

_____

Modem

Once the decision has been made on the type of telecommunications device, you can proceed to choosing the type of modem that is compatible with this device. The manufacturer can provide information on the types of telecommunication devices that are compatible with their modem and software. Sometimes a special connector and /or software is needed to connect the telecommunication device to the modem. The modem needs to transmit at an optimum baud rate. Often the cellular/satellite connection changes the baud rate of transmission, so this may be another issue to discuss with the manufacturer.

Modem:			**Cost**
Model #1	_____	❑	_____
Manufacturer	_____		
Compatibility	_____		
Baud rate	_____		
Connection kit	_____	❑	
Software	_____	❑	
Model #2	_____	❑	_____
Manufacturer	_____		
Compatibility	_____		
Baud rate	_____		
Connection kit	_____	❑	
Software	_____	❑	
Model #3	_____	❑	_____
Manufacturer	_____		
Compatibility	_____		
Baud rate	_____		
Connection kit	_____	❑	
Software	_____	❑	

Computer Hardware

When looking into laptop computers it is necessary to keep in mind what components will be needed for the completion of the document. This type of project requires fast processing speeds, large amounts of RAM and hard drive space. It may seem like one gigabyte of hard drive space is an enormous amount of space, but when saving photographic images they take up large amounts of disk space. It may be feasible to look into purchasing an external drive, such as a Zip or Optical drive, for storage and archival purposes.

The type of computer system, whether PC or Mac, is not as important as the capabilities and compatibly it has with the user, and other peripherals that will be needed. It is even possible, depending on the size of your operation, that you may have more than one kind of system available.

In remote locations power source is an important factor to consider. If you are running the system entirely off of batteries, it is important to have at least one set for backup. If a charging system is in place, one set of batteries can charge while the other set is being used. Other charging options are available such as connection to the automobiles' power system, generator and/or solar systems.

Make sure that all cables to any other device being used are present. A test run before leaving for that remote location is advisable. If any cables are damaged or not compatible, it will show up in the test run. If budget and space allow, backup cables should be included.

Computer:			**Cost**
Model #1	_____	❑	_____
Processor/speed	_____	❑	
RAM	_____	❑	
Internal hard drive	_____	❑	
CD ROM	_____	❑	
Battery	_____	❑	
Screen size	_____	❑	
Expansions ?	_____	❑	
	_____	❑	
	_____	❑	

Computer:			**Cost**
Model #2	_____	❑	_____
Processor/speed	_____	❑	
RAM	_____	❑	
Internal hard drive	_____	❑	
CD ROM	_____	❑	
Battery	_____	❑	
Screen size	_____	❑	
Expansions ?	_____	❑	
	_____	❑	
	_____	❑	
Model #3	_____	❑	_____
Processor/speed	_____	❑	
RAM	_____	❑	
Internal hard drive	_____	❑	
CD ROM	_____	❑	
Battery	_____	❑	
Screen size	_____	❑	
Expansions ?	_____	❑	
	_____	❑	
	_____	❑	

Computer Software

This type of project involves the use of several different software packages. The user should be familiar with the software that is to be used.

A page layout software will be needed to produce the document. The top three used in the industry are: Quark XPress, Adobe PageMaker, and Ventura Publishing. This type of software will allow you to design the page layout, import text, graphics and photographs.

Photo manipulation software will be needed to work with photographic images. Programs such as Adobe PhotoShop and Live Picture are available. These programs do not download digital images from the digital camera, so you will need additional software to link your camera to your computer.

Drawing programs allow the user to produce line drawings. Some of these programs are also capable of creating charts and graphs. Popular drawing programs are: Adobe Illustrator, Macromedia Freehand, and Corel Draw.

If you are using the Internet as access to your digital printer, you will need software and an Internet provider to connect you to the Internet. It is advisable to contact the person in charge of the digital printer to determine what kind of connection they require to receive your transmitted document for production. Some printers use the internet as means of transmitting information while others use a direct link from your modem to their file server. If this is the case, they often have proprietary software which you will need installed on your computer.

Any other peripherals that you connect to your system may need additional software. ***Again*** a test run of the system will let you know your problem areas.

Software:			**Cost**
Page layout	1 _____	❑	_____
	2 _____	❑	_____
Graphics	1 _____	❑	_____
	2 _____	❑	_____
Image processing	1 _____	❑	_____
	2 _____	❑	_____

Software: **Cost**

Internet 1 _____ ❑ _____

2 _____ ❑ _____

Other _____ ❑ _____

_____ ❑ _____

_____ ❑ _____

_____ ❑ _____

Digital Camera

The type of documentation you are producing will determine the quality of digital camera you purchase. There are many types of digital cameras available on the market today. Not all of them produce high quality images. When investigating the type of camera to buy keep in mind the type of output device you are printing to, the quality and detail needed in the image, and the amount of storage the device is capable of. These factors will help in determining the quality of camera you will need. Most digital cameras have proprietary software for downloading the image information to the computer. Make sure that software and cabling are included.

Digital Camera: **Cost**

Model #1 _____ ❑ _____

Resolution _____

Options _____

Software _____ ❑ _____

Cables/Connects _____ ❑ _____

Model #2 _____ ❑ _____

Resolution _____

Options _____

Software _____ ❑ _____

Cables/Connects _____ ❑ _____

Digital Camera: **Cost**

Model #3	_____	❑	_____
Resolution	_____		
Options	_____		
Software	_____	❑	_____
Cables/Connects	_____	❑	_____

Extras: **Cost**

Hard drives	_____	❑	_____
	_____	❑	_____
Recharge systems	_____	❑	_____
	_____	❑	_____
Portable printer	_____	❑	_____
	_____	❑	_____
Cables/Connects	_____	❑	_____
	_____	❑	_____
Batteries	_____	❑	_____
	_____	❑	_____
Internet Provider	_____	❑	_____
	_____	❑	_____

Digital Presses

There are a variety of digital presses available today. These digital presses can print black and white, like a Xerox Docutech, or color, like a Cannon CLC800 copier. The printer you use connected to your computer is considered a digital press. A digital press prints materials directly from digital information.

These digital presses have a file server networked to them so that information can be downloaded and stored on the server till the document is ready to be printed. An outside connections to the file server is made through a modem. There are several different ways the transmission is made to the server. Some print shops use a direct link and proprietary software to make the connection. Others use the internet as means of logging on and downloading files.

No matter where you want to print to you should have prior contact with that print shop. You can shop for digital printers on the internet. You will need to find out what parameters your job will require in order for it to print properly. You also need to decide whether you want to print black and white or color. Color has its own set of problems and creates larger file sizes.

Some of the parameters you need to inquire about are: How the file will be saved for transmission. What type of resolution does the device have. Does it require images to be in halftone format or contone. How do you want the document to be printed: one sided, two sided, head to head, head to toe. What are the minimum and maximum page sizes. What kind of paper can be used. What finishing options are available. Does the document need to be bound. Will the document need to be delivered once it is finished and how will that be accomplished. You may want to try a test run before going out on location.

Digital Press: **Cost**

Digital press #1 _____ ❑ _____

Resolution _____

Color/B&W _____

Halftone/Contone _____

Min/Max page size _____

Types of paper _____

Digital Press: **Cost**

Binding Options _____

Delivery options _____

Transmission specs _____

_____

Other _____

Digital press #2 _____ ❑ _____

Resolution _____

Color/B&W _____

Halftone/Contone _____

Min/Max page size _____

Types of paper _____

Binding Options _____

Delivery options _____

Transmission specs _____

_____

Other _____

Digital press #3 _____ ❑ _____

Resolution _____

Color/B&W _____

Halftone/Contone _____

Min/Max page size _____

Types of paper _____

Binding Options _____

Transmission specs _____

_____

Delivery options _____

Other _____

_____

The Process

First you will need to capture what photographic images you will use. Since each camera is different, you will need to familiarize yourself with the specific functions of your camera. Digital cameras with lens options may allow you to use a macro setting for very close shots. Some cameras are equipped with LCD screens so that you can view the image once it has been captured. On many models unwanted images to be deleted so another image can take its place.

Once your camera has filled its storage capacity you will need to download the images to the computer. This usually involves a cable attached from the camera to the computer. Others use a storage card which works with the type II PC card slot in your computer. Downloading image files can take some time, so be prepared for a wait.

With the images in the computer, photo manipulation can now take place. Some images may need more enhancement than others. Each one is different. You need to know what type of digital press your final output will be produced on. You will then need to work with the images, preparing them for that specific printing device. If you are printing to a color digital press, then you will need to address the color issues that go along with color printing.

If you are developing drawings, charts or graphs, you will want to prepare them before working on your page layout. Once all your images are complete you are ready to prepare the page layout. Some people like to produce text within the page layout program while others use a word processing program to produce text. If you use word processing it means another piece of software to work with and store on the computer.

A word of caution about fonts. The more fonts you use the larger your final file size will be. If you look at one font family, like Helvetica, you may end up using bold, medium, italic and bold italic. The computer distinguishes this as four separate fonts. You can see that by using several different families and the options within each family, the file size can get out of control.

When the document is completed, proofed and ready for output you will need to save the file in some format for transmission. Most often it is saved to a Post Script file. This will incorporate the fonts and images into one file. Since each platform and each software has its own system of saving PostScript files, you will need to check you software manuals for procedures on how to complete this task. Again, having prior contact with the person who will be producing your final output, you should be given specific information on how to prepare your files for transmission.

You are now ready to transmit your document. Make sure that your batteries on all units are fully charged before beginning. A low battery on the computer and/or telecommunication device could impede your transmission. Depending on the file size, it may take some time to complete the transmission of the file.

At the present time the cost of such an operation may be prohibitive for practical daily use. As the cost of electronic equipment comes down in price and becomes more avail-

able, this type of operation may become common. For those occupations that are required to work in remote locations they will now have the convenience of being able to print documents within a short time to one or many destinations.

Summary of List

Telecommunications		**Cost**
Type of Service	_____	_____
Device	_____	_____
Modem		
Manufacturer	_____	_____
Model	_____	
Compatibility	_____	
Baud rate	_____	
Connection kit	_____	
Software	_____	
Computer:		
Model	_____	_____
Processor/speed	_____	
RAM	_____	
Internal hard drive	_____	
CD ROM	_____	
Battery	_____	
Screen size	_____	
Expansions?	_____	
	_____	
Software:		
Page Layout	_____	_____
Graphics	_____	_____
Image Processing	_____	_____

Software:		**Cost**
Internet	_____	_____
Other	_____	_____
	_____	_____
	_____	_____
Digital Camera:		
Model	_____	_____
Resolution	_____	
Options	_____	
	_____	
Software	_____	
Cables/Connects	_____	
Extras:		
	_____	_____
	_____	_____
	_____	_____
	_____	_____
Digital Printer:		
Output Device	_____	_____
Resolution	_____	
Color/B &W	_____	
Halftone/Contone	_____	
Min/Max Page size	_____	
Types of paper	_____	
Binding options	_____	
Transmission specs	_____	
Delivery options	_____	
Other	_____	
Total Cost of System		_____

Example

Summary of List

		Cost
Telecommunications		
Type of Service	Frontier Cellulare	$360/yr + 10¢/min
Device	Motorola Elite Cellphone	150.00
Modem		
Manufacturer	Global Village	220.00
Model	PowerPort Platinum PC Card	
Compatibility	Motorola	
Baud rate	33.6	
Connection kit	Extra	50.00
Software	Included w/ connection kit	
Computer:		
Model	Macintosh PowerBook 3400	5499.00
Processor/speed	240MHz PowerPC 603e	
RAM	16 MB	
Internal hard drive	3.0 GB	
CD ROM	12X	
Battery	32 watt lithium-ion (4 hour charge)	
Screen size	12.1 800x600 pix	
Expansions?	Additional hd bay 2 PC card slots	
Software:		
Page Layout	Quark XPress 3.32	660.00
Graphics	Adobe Illustrator 7.0	360.00
Image Processing	Adobe Photoshop 4.0	included w/digital camera

Software:

		Cost
Internet	NetScape	60.00
Other	Internet Provider	
	AOL	480.00/yr

Digital Camera:

Model	Kodak DC120	800.00
Resolution	1280 X 960 pixels - 24bit color	
Options	2MB internal Storage	
	Macro lens setting	
Software	Picture Transfer + Photo Enhancer	
Cables/Connects	included	

Extras:

Zip Drive + 10 disks	300.00
Ram Chip - 32 MB	900.00
HP Portable Deskjet Printer	350.00
Extra battery + Charger + AC adapt.	900.00

Digital Printer:

Output Device	DocuTech 9500	20.00 transmission fee
Resolution	600 dpi	0 - 100 copies 15¢@
Color/B &W	B & W	100 - 200 copies 12¢@
Halftone/Contone	Both	200 - 300 copies 10¢@
Min/Max Page size	8½X11" → 11X17"	300 - 500 copies 9¢@
Types of paper	Bond → some cardstock	500 + 8¢@
Binding options	Booklet w/heat bind or staple	
Transmission specs	Internet access post script file format	
Delivery options	local	
Other		

Total Cost of System $10,064.00

Vita

Vita

Brenda Beden was born and raised in New Mexico. She has spent most of her life in the western United States.

When Brenda set off for college, she knew she wanted a career that would be versatile. She had an interest in art and decided that a career in the printing field would satisfy her needs. Brenda received her AAS degree in Graphic Communications from Mesa State College, in Grand Junction, Colorado.

From there Brenda went on to work in industry for several years. She worked for the City of Grand Junction as the in-house printer. Later she worked as a micrographics operator for Bendix Field Engineering Corp.. Brenda began teaching Graphic Communications at Mesa State College on a part-time basis, later to be hired on full-time when the program was expanded to include commercial art. She held that position for fifteen years at which time the program was cancelled. During that time she received her Bachelors degree in Fine Art with an emphasis in Print Making.

Brenda wished to continue teaching and knew she would need her Masters degree to achieve that goal. Based on its fine reputation, Rochester Institute of Technology was her choice of schools. She picked her thesis topic after traveling to Chaco Canyon for visit and simultaneously working at a printshop that used a Docutech for the majority of their work.

Brenda is married and has two sons. Her family has traveled with her to Rochester and has been her support group while attending school.